THE BONY IMPRINT OF PREGNANCY

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SKELETAL evidence of past pregnancy may aid the forensic identification of remains when the medical history is known, and is of value in paleoanthropology. It is also noteworthy that its presence is the only *conclusive* skeletal evidence of sex. For all this, it is not widely appreciated that pregnancy does leave an imprint on the bones of the pelvis and that this imprint is clear, easily recognised, and rarely equivocal.

In developing descriptions of these bony changes of pregnancy data both from autopsy material of known parity and from paleoanthropological material have been utilized.

THE IMPRINT

The evidence of past pregnancy appears on the bone adjacent to the joints of the pelvis—the pubic symphysis and the sacroiliac joints.

At the symphysis the evidence appears as smooth-walled pits or craters on the posterior surface of the pubic bone (Figure 1). There may be one or several craters, each measuring up to a centimeter in both depth and diameter.[1]

At the sacroiliac joint the imprint appears chiefly as a modification of the preauricular groove of the ilium.[2] The groove is formed by the strong inferior portion of the anterior ligament of the joint. In males and in females who have not been pregnant the essential feature is a flat floor to the groove, which is of constant depth. It is more commonly shallow but may be quite deep. Width is variable, but the groove frequently extends about half a centimeter laterally to a small tubercle on the ilium (Figure 2).

The form of the groove in a woman who has been pregnant is different from this. Now the groove is found to be made up of a series of pits or craters of the same form as those on the posterior surface of the pubic bone (Figures 3, 4). Sometimes the pits are elongated, as

Fig. 1. Posterior view of pubic bones of 41-year-old female who bore four children. Marked pitting is evident on the right bone in its lower part.

though the bone had been scooped out. The groove now being made up of a series of pits, it presents an irregular floor, i.e., the groove is of irregular depth, with slight ridges where adjacent pits meet. Usually the groove of pregnancy is deeper than in the nonpregnant form and also tends to extend more superiorly on the anterior margin of the bone adjacent to the joint. However, size and depth of the groove are not the essential features, and some grooves that clearly show this coalescence of pits may be quite short and shallow.

Of these two sites, the symphysis and the preauricular groove, the latter usually bears the more distinct imprint. This is shown in the accompanying table, which presents data from a prehistoric Polynesian population. The degree of pitting has been subjectively assessed as either slight or moderate to marked. On any one pelvis the markings at the groove are nearly always more conspicuous than the markings at the symphysis.

Discussion

A consideration of certain changes that occur at the joints of the

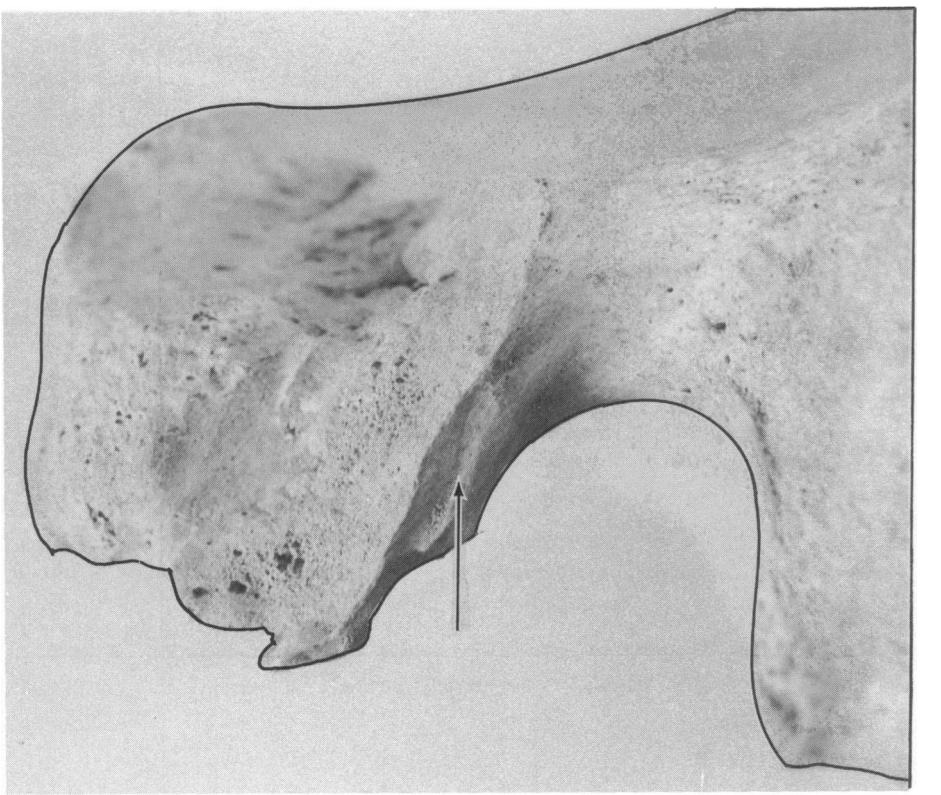

Fig. 2. Left ilium, medial view of the auricular surface and adjacent area, showing the typical nonpregnant form of groove, indicated by the arrow. Female pelvis.

pelvis during pregnancy offers an explanation for this bony imprint.

In the fourth month the ligaments of the joints start to soften and relax, a process mediated by estrogens and the placental hormone relaxin. Such relaxation allows a significant expansion of the birth canal during delivery by the opening of the symphysis and sacroiliac joints and by rotation of the sacrum during descent of the head. Synchronously with this softening and relaxation of the ligaments there occurs adjacent to their attachments an active resorption of bone. Histological sections at this time show osteoclasts lying in these areas of resorption.[3] Similar changes have been observed in other animals.[4]

During delivery the softened ligaments are stretched and some rupture of fibers may occur. Examination of the area of attachment reveals variable edema and hemorrhage.[5] Following delivery the proc-

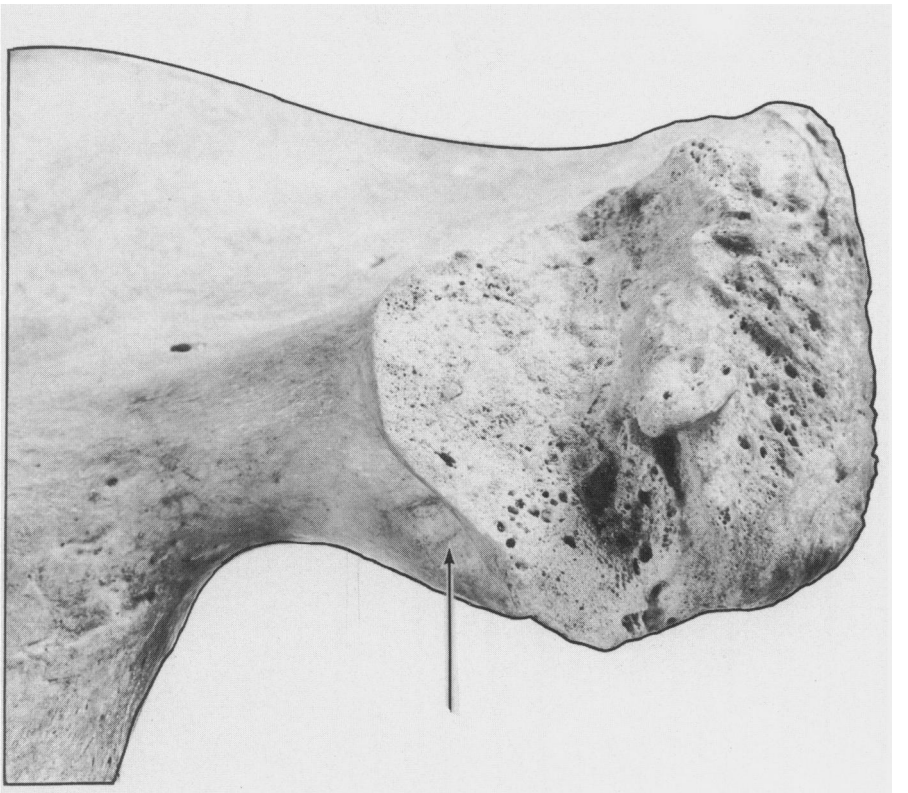

Fig. 3. Right ilium, similar view to Figure 2, showing pitted form of groove (arrow), indicating previous pregnancy.

esses of reorganization and repair gradually return the ligaments to their normal state within a few weeks. Thereafter, a slow and variable replacement of bone appears to occur over years at the sites of previous osteoclastic activity.

Of this sequence, it is probably the osteoclastic erosion at the site of attachment of the ligaments that is chiefly responsible for the bony imprint of pregnancy.

The explanation for the more conspicuous changes at the ilium may be that the sacroiliac joint is in the line of weight transfer from spine to leg, and changes here may be exaggerated as a consequence of the increased weight on laxer ligaments for many months. In contrast, the pubic symphysis is out of the line of weight transfer, and stress here may be confined mainly to the period of labor.

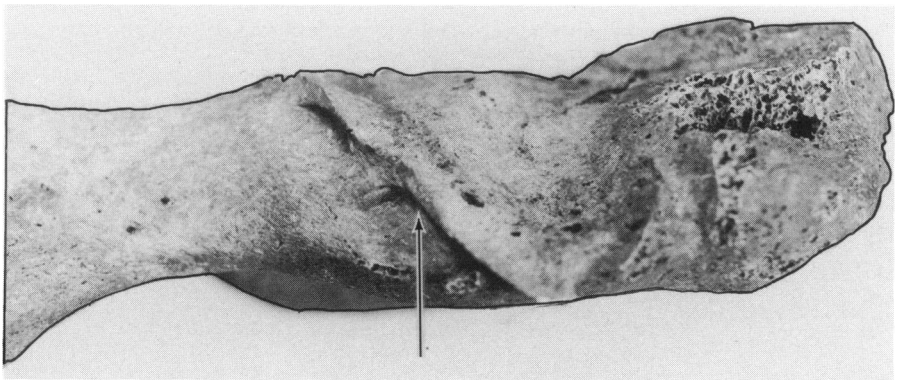

Fig. 4. Right ilium, inferior view of auricular area, showing pitted form of groove (arrow).

COMPARISON BETWEEN DEGREE OF PITTING ON THE PUBIC BONE AND AT THE PREAURICULAR GROOVE FOR 50 PREHISTORIC POLYNESIAN SKELETONS SHOWING THE BONY IMPRINT OF PREGNANCY*

	Pre-auricular groove			
	Slight		*Moderate to marked*	
Pubic bone	*No.*	*%*	*No.*	*%*
None	2	4	2	4
Slight	4	8	16	32
Moderate to marked	2	4	24	48

*No pelvis showed pitting at the pubic bone in the absence of pitting at the pre-auricular groove.

Erosion of bone also occurs at the sites of attachment of other ligaments of the sacroiliac joint, notably where the interosseous ligament is attached to the ilium. From this site erosion may extend around the inferior margin of the joint to join the preauricular groove. The inferior part of the articular surface then appears as a plateau above the eroded peripheral bone. However, some natural depression of the bone may occur here both in males and in females who have not been pregnant, so the appearances at this posterior part of the joint may be more difficult to interpret. Similarly, while there is no doubt that erosion of bone occurs where the interosseous ligament attaches to the sacrum, the natural irregularity of this surface makes interpretation difficult.

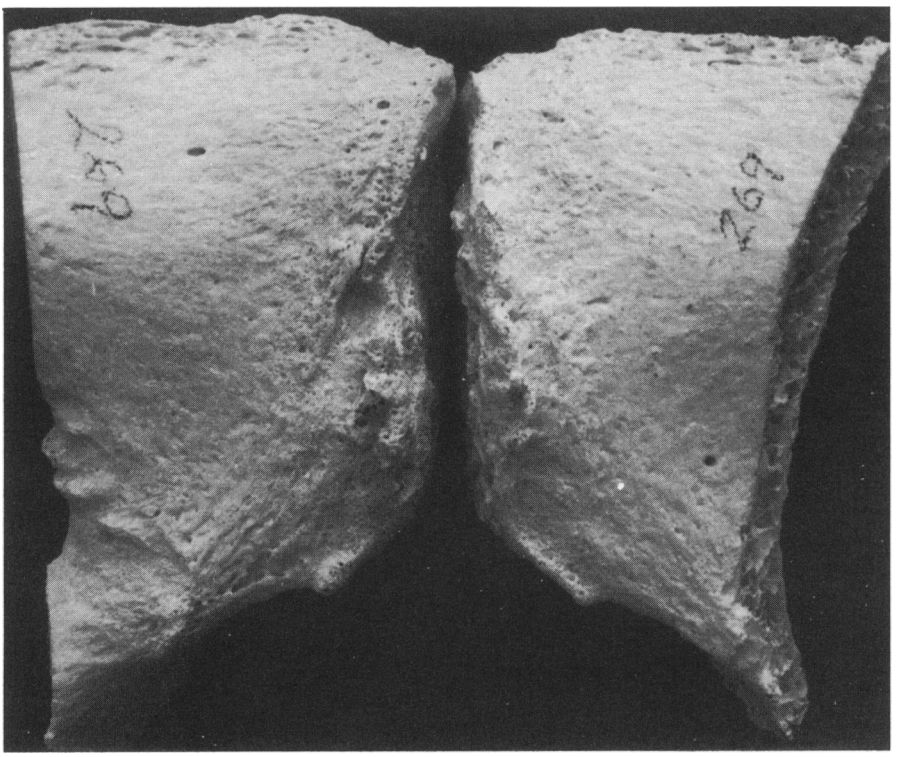

Fig. 5. Posterior view of pubic bones from an 88-year-old woman who had borne one child. Despite some arthritic change, a pit of pregnancy is still evident on the left bone about halfway down.

After pregnancy the pits slowly become shallower over years, although even some 50 years after childbearing they may still be evident (Figure 5). Such continuing replacement of bone renders difficult an attempt to correlate the degree of pitting with the number of children borne. It may eventually be possible to develop standards from autopsy material, but age at death will certainly have to be taken into account. In old age arthritis at the symphysis also may obscure pitting, or may give rise to a spurious pitting which is rough and usually readily distinguished. Any degree of ankylosis at the sacroiliac obliterates the evidence at the preauricular groove at an early stage.

Modern western populations tend to have less conspicuous pitting, at the pubic symphysis at least, than do prehistoric populations or those from developing countries. Several factors may be involved here.

Modern western women probably average far fewer labors; modern autopsy material in western populations tends to be derived from older groups; obstetrical care being better today, there may be less trauma during labor; and less physical activity during pregnancy may lessen the changes. Much more autopsy material needs to be studied in order to clarify these matters.

Summary

Bony evidence of past pregnancy appears as smooth-walled pits or craters on the posterior surface of the pubic bone adjacent to the symphysis and at the preauricular groove of the ilium. Of these two sites the preauricular groove provides the clearest testimony. The pits are probably a consequence of hormone-induced osteoclastic activity in the vicinity of the attachments of the ligaments of the pelvic joints during pregnancy.

Acknowledgment

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